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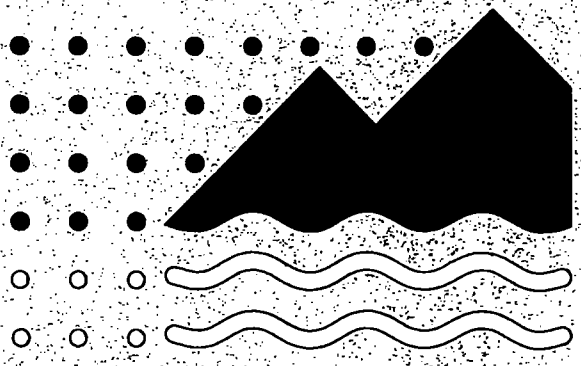
Final Report
Geophysical Survey
Waste Pit Detection/Delineation
4 Areas – 0.3, 3.5, 1 and 1 Acre Sites
Former Flow Laboratories Site
Dublin, VA
Enviroscan Project Number 050048



ENVIROSCAN, INC.®

TASK WORK PLAN
GEOPHYSICAL SURVEY

FOR

FORMER NEW RIVER STORAGE DEPOT (NRSD), VIRGINIA

FLOW LABORATORY SITE

SECOND ROUND SURVEY

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION III

Prepared by

GANNETT FLEMING, INC.
Harrisburg, Pennsylvania

JULY 2000

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TASK WORK PLAN FOR GEOPHYSICAL SURVEY
FORMER NEW RIVER STORAGE DEPOT,
FLOW LABORATORY SITE,
PULASKI COUNTY, VIRGINIA
JULY 2000

Introduction

Gannett Fleming, Inc. has been tasked with conducting a second round of independent geophysical surveying at the old Flow Laboratory site in Pulaski County, Virginia, in support to EPA. The site is located on property that was part of the New River Storage Depot (NRSD) until deeded to other owners in 1963. Geophysical surveying was conducted in 1999 at this site, with the intent of locating suspected animal burial trenches that were presumed to exist during laboratory operations in the 1970 to 1985 time frame. The 1999 survey was conducted in the area of the drain fields, shown on Figure 1.

The planned activities are for Gannett Fleming to design the field survey plan for EPA approval and have a team consisting of Gannett Fleming and the geophysics subcontractor perform a non-intrusive geophysics survey at four (4) locations, which are depicted on Figure 2. Aerial photographs, keyed to Figure 2, are included as an attachment to this work plan.

Site Description

The New River Storage Depot (a.k.a. New River Ordnance Plant) is located in Pulaski County, Virginia, near the community of Dublin. The NRSD site originally consisted of 3,840 acres. Currently, a total of 2,813 acres are still operated as part of the Radford Army Ammunition Plant. The remaining acres, which were deeded or transferred to other owners or users, includes the Flow Laboratory site, which is currently owned by Mar-Bal, Inc.

New River Storage Depot History

As reported in the New River Ordnance Plant Archives Search Report dated September 1993, the history of the facility dates back to the American Revolution. In the modern era, it was not until the United States prepared for World War II that the need for increased munitions production again became a priority. An Act of Congress granting authority for the construction of plants for the production of munitions, materials, equipment, and supplies with the goal of strengthening the Armed Forces of the United States was the basis for opening the New River Ordnance Plant. The Government operated the plant under contract with the Hercules Powder Co. Of Wilmington, Delaware. The mission of this facility was the loading of propellant and igniter charges and the manufacture of the bags used for such charges.

During the post-war period, the War Assets Administration began disposal of portions of the former New River Ordnance Plant, starting as early as 1947-48 and continuing through 1978. While approximately 1,000 acres in the western portion of the original facility (with future the Flow Lab

site) had been sold or transferred for other uses, the central bag-loading and igniter areas, burning grounds and rail shipping area remain as part of the NRSD, in addition to nearly 150 high explosives magazines, black powder igloos and smokeless powder igloos in the eastern portion of the facility.

Flow Laboratory History

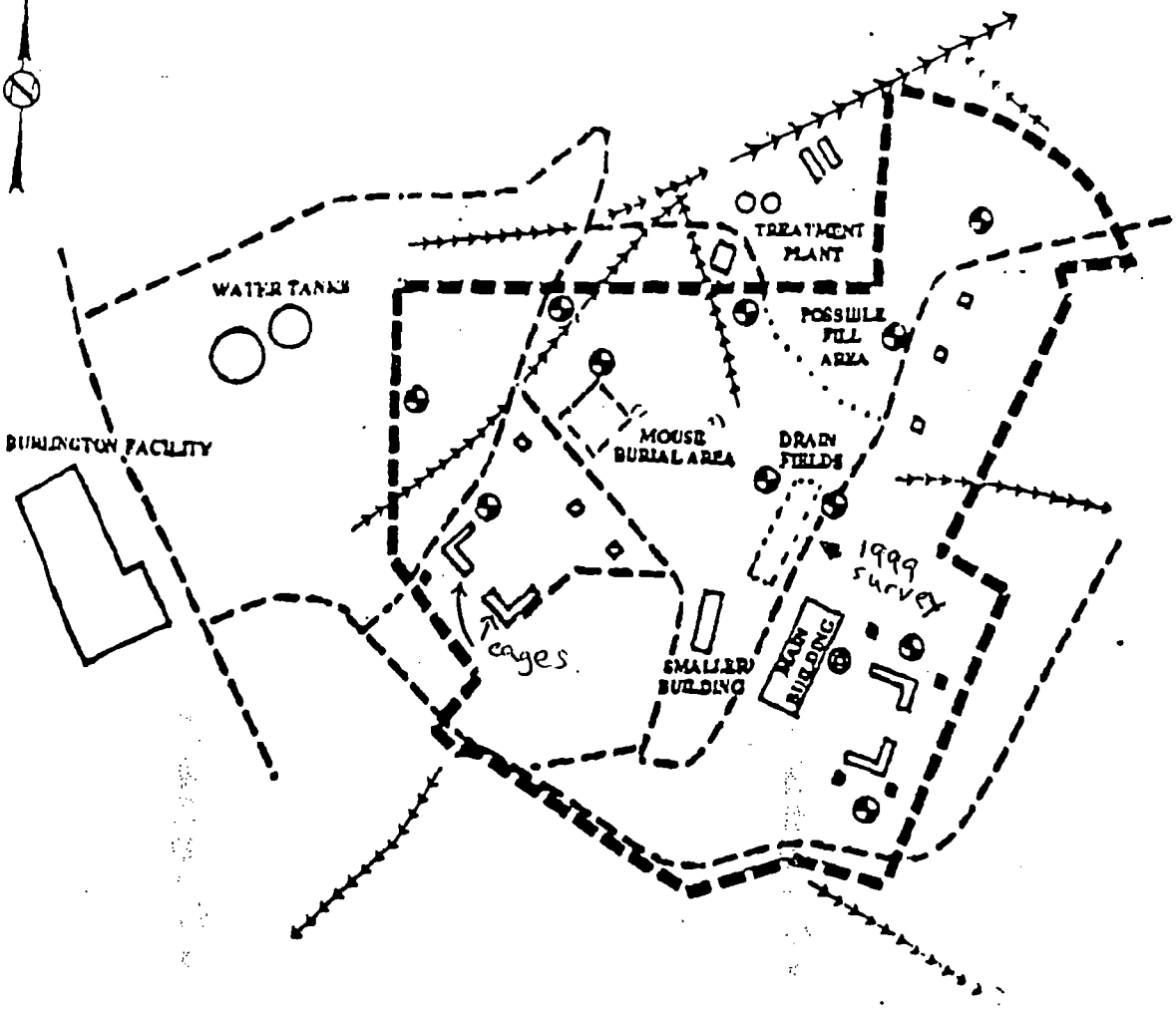
Flow Laboratory appears to have begun activities on site about 1970. This facility was owned and operated by the Flow General Company, under the direction of their regional headquarters located in McLean, VA. Flow General operated nationwide and in 18 countries around the world. Their products included cell cultures, blood cells, bacteriological products, selected viral reagents, plastic labware, and instrumentation. In 1999, Gannett Fleming found a 1983 product catalog, in an old storage building, which described the operations at the Dublin facility.The catalog indicated that Flow labs had the space and facility to house all types of small and large animals. Complete blood cell product services, including selection, housing and care of animals, test bleedings, inoculation, blood collection and serum preparation, according to requested customer protocols, were provided. The animals housed at the facility are believed to have been included: cows, chickens, geese, guinea pigs, monkeys, rabbits, rats, sheep, and swine. During field investigations by Gannett Fleming staff, there was evidence of labware: petri dishes, sample vials, sample labels and syringes.

Scope of Work

Both EPA and the Commonwealth of Virginia are concerned that animal carcasses and labware may have been buried on site during the operational life of Flow Labs (circa 1970-1985). There is an absence of information/documentation that either offsite incineration or offsite disposal occurred. The likelihood of onsite burial raises the concern that a future site developer may unearth wastes that may constitute a biohazard of unknown dimensions and/or level of hazard.

Given the unknown specifics of the problem, it has been determined that the most prudent form of investigation should be nonintrusive in nature. In 1999, a geophysical survey was conducted at the area identified as the drain field (see Figure 1) using a combination of ground penetrating radar (GPR) and an electromagnetic (EM) terrain conductivity survey. The survey did not detect any evidence of carcass burial trenches rumored to be there. The survey did detect and delineate two septic leaching fields.

Based on historic activities and a review of aerial photographs, four areas have been delineated for a second geophysical survey using a combination of GPR and EM (or other geophysical methods deemed appropriate). The four areas are depicted in Figure 2 and further identified through review of attached EPA EPIC Figures 9, 10 and 11. The output of the work effort by the geophysics subcontractor would be a task report that describes subsurface features and conditions, based on their field investigation. A sample Subcontractor Purchase Order is also included as an attachment to this Work Plan.



0 1000 2000 3000
APPROXIMATE SCALE (FEET)

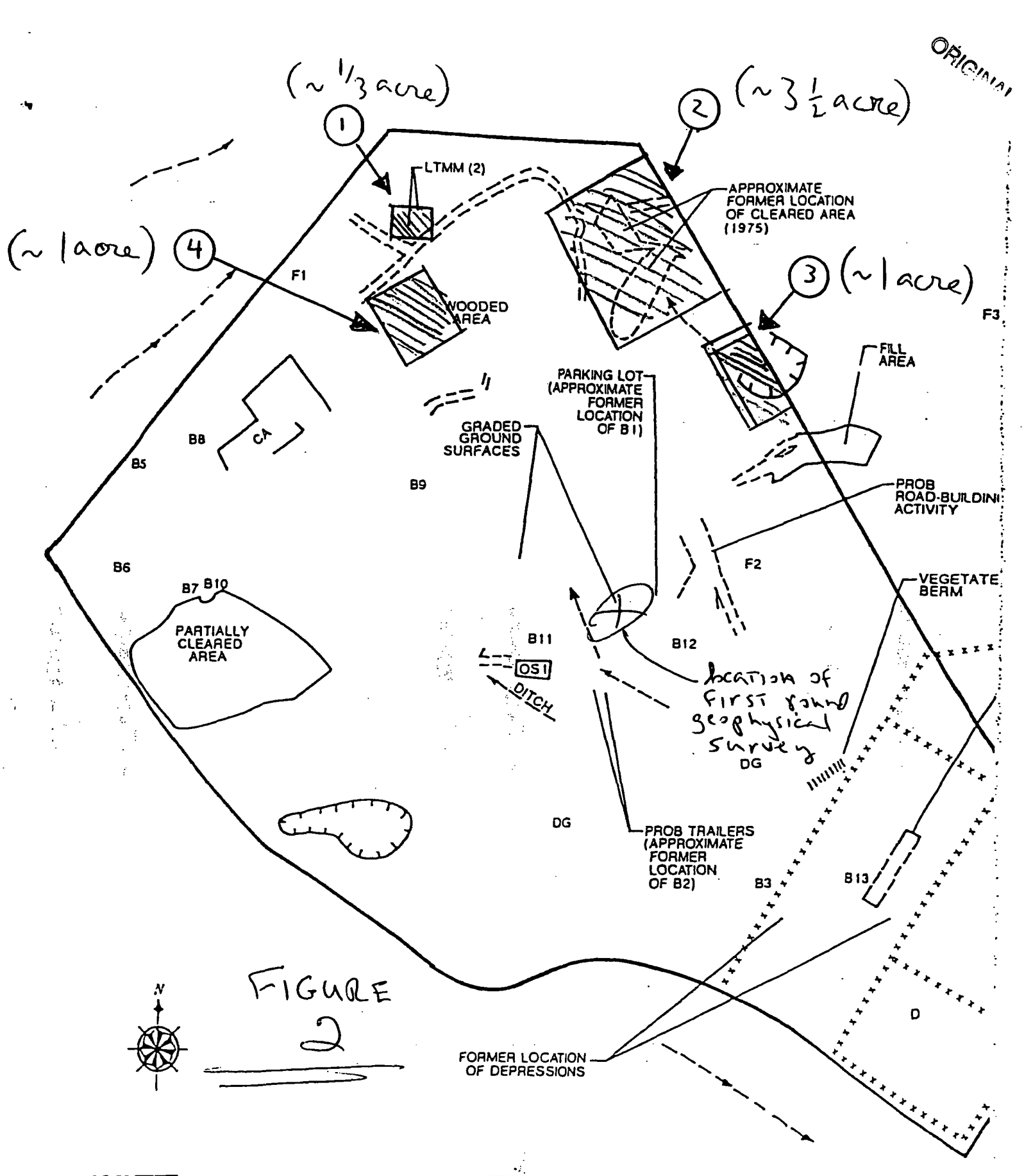
⊕ - PROPOSED WELL LOCATIONS

Ref: ADAPTED FROM A 1978 TOPOGRAPHIC MAP PROVIDED IN A PHASE I ENVIRONMENTAL ASSESSMENT BY OTHERS, DATED AUGUST 9, 1994.

LAW ENGINEERING, INC.
ROANOKE, VIRGINIA

FLOW LABORATORY/ICN PROPERTY
140 ACRE TRACT
DUBLIN, VIRGINIA

PRO NO. PRK-159E4 | FIGURE 1



EPIC

Figure 10. Flow Labs site, September 21, 1981. Approximate scale 1:4,260.

Figure 10. Flow Labs site, September 21, 1981. Approximate scale 1:4,260

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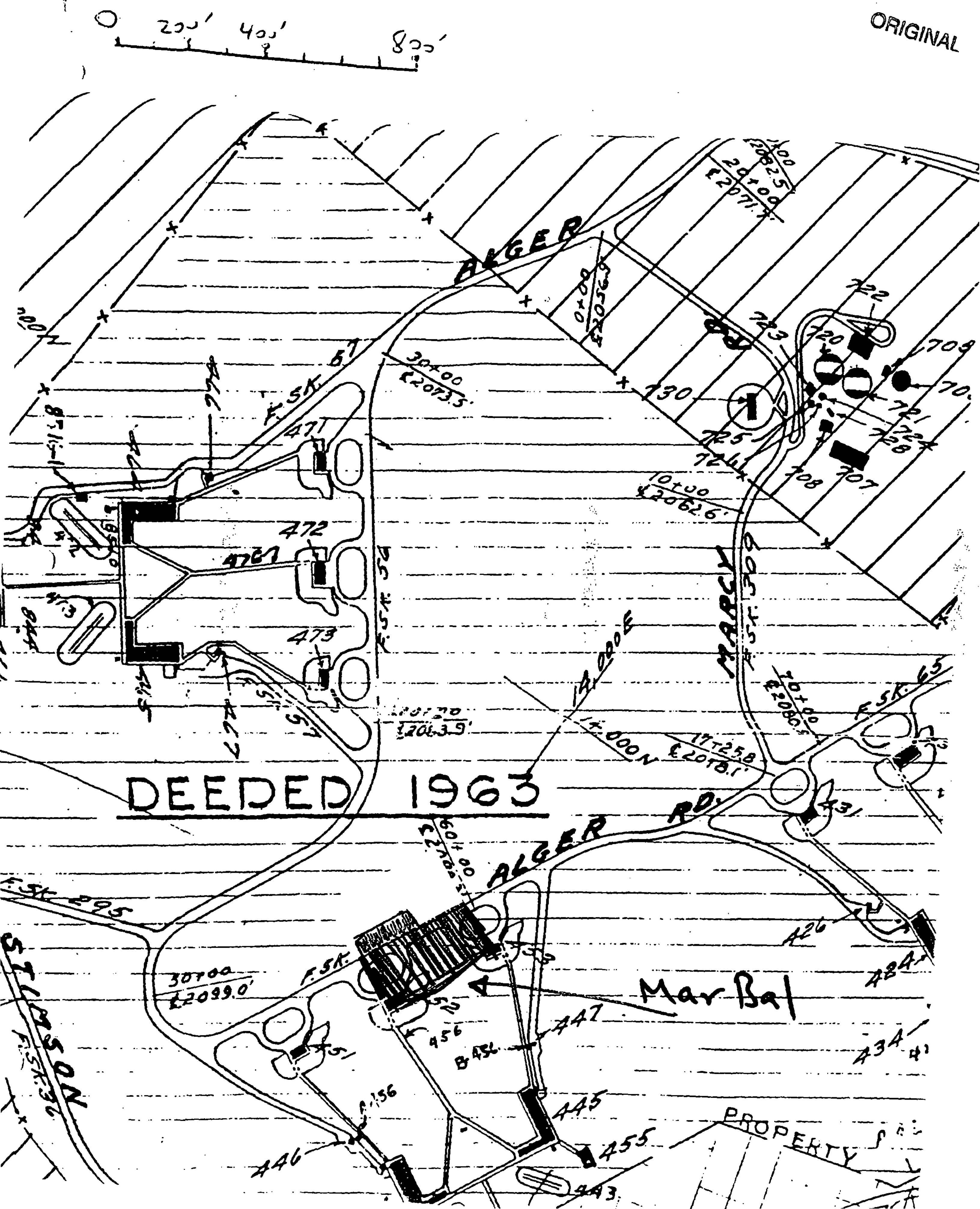
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Final Report
Geophysical Survey
Waste Pit Detection/Delineation
4 Areas – 0.3, 3.5, 1 and 1 Acre Sites
Former Flow Laboratories Site
Dublin, VA
Enviroscan Project Number 050048

Prepared For: Gannett Fleming, Inc.
Prepared By: Enviroscan, Inc.
September 28, 2000

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ENVIROSCAN, INC.

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September 28, 2000

(b) (4)

Gannett Fleming, Inc.
P.O. Box 67100
Harrisburg, PA 17106-7100

RE: Geophysical Survey
Waste Pit Detection/Delineation
4 Areas – 0.3, 3.5, 1 and 1 Acre Sites
Former Flow Laboratories Site
Dublin, VA
Enviroscan Project Number 050048

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Pursuant to our proposal dated May 26, 2000, Enviroscan, Inc. has completed a geophysical survey of the above-referenced site. The methods and results of the survey are described below.

Purpose and Background

The site is a portion of the former New River Storage Depot and was reportedly formerly occupied by an animal research laboratory. The survey areas consisted of four regions where the possible presence of trenches containing animal carcasses was suspected. The four areas were chosen by others based on aerial photo interpretation (by others), and the presence of suspected dirt mounds. The purpose of the geophysical survey was to detect and delineate possible trenches in these four areas.

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Methods

To ensure detection of suspected non-metallic, organic material (i.e. carcasses) in the rumored trenches, an electromagnetic (EM) terrain conductivity survey was conducted between September 12, and 13, 2000. In order to provide an independent method of detecting and delineating non-metallic subsurface materials, a ground penetrating radar (GPR) survey was conducted on September 13, 2000. The principles of these techniques and the specific tasks completed by Enviroscan are described below.

EM

Enviroscan performed EM mapping using a Geonics EM-31 instrument. The EM-31 was selected since it is sensitive to minor changes in the electrical conductivity of subsurface materials due to slight variations in the organic, ionic, or soil moisture content of soils. The EM-31 employs an electromagnetic transmitter coil to induce an electric current in the earth. This current creates a secondary electromagnetic field that is measured by a receiver coil at a fixed separation of 3.7 meters from the transmitter coil. The secondary electromagnetic field has two components. The quadrature component is proportional to the bulk electrical conductivity or terrain conductivity (in millimhos per meter or mmho/m) of the subsurface materials. The inphase component (in parts per thousand or ppt) is primarily a measure of the relative concentration of metallic material in the subsurface. Note that in the presence of extremely high terrain conductivity material, the dynamic range of the EM-31 can be exceeded (or "saturated"), and the instrument will register spurious negative conductivities (a physical impossibility). These negative conductivities therefore actually represent very high positive conductivities. Similar saturation in the presence of significant metal can cause a spurious negative inphase response, which should also be interpreted as a very high positive value.

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For this survey, Enviroscan employed an EM-31 in vertical dipole mode. The effective survey depth of the EM-31 is depicted in Appendix A. The instrument is almost completely insensitive to material at the ground surface, and has a peak sensitivity to material at a depth of approximately four feet (see incremental sensitivity curve in Appendix A). Below four feet, the sensitivity diminishes approximately logarithmically. The cumulative effect of this varying sensitivity is also depicted in Appendix A. As the cumulative sensitivity curve shows, approximately 80 percent of the signal originates at depths less than 30 feet. Therefore, the terrain conductivity or inphase response measured by the EM-31 in vertical dipole mode represents primarily subsurface electrical properties at a depth of four feet (a depth which corresponds closely with the suspected four to six foot depth of the rumored trenches). There is little to no contribution to the EM-31 response by material at the ground surface, and moderate (and diminishing) contribution from materials down to approximately 30 feet. Note that the manufacturer's nominal effective survey depth is 20 feet. The vertical dipole EM-31 was selected to screen out the potentially time-varying effects of surficial variations in ground cover and soil moisture content material, while maintaining an appropriate survey depth. Note that the EM-31 sensitivity is not downward-focused – i.e. it is somewhat sensitive to large above-ground or overhead targets out to a distance of approximately 20 feet.

The EM survey was completed by collecting vertical dipole mode terrain conductivity and inphase data along an ad-hoc system of profiles covering each of the four survey areas (see Figures 1-A and 1-B). Along survey profiles, measurement stations were defined by automatically triggering matching inphase and conductivity readings at one-second intervals, as the instrument was hand-carried. Based on the varying walking speed of the operator, this resulted in a station spacing along profiles of approximately 2 to 5 feet.

The actual location of each measurement station was digitally recorded using a backpack-mounted Trimble Pathfinder global positioning system (GPS) receiver in contact with six to eight position-fixing satellites. The GPS positions were differentially corrected using data from a fixed-position community base station in Charlottesville, VA. The resulting differential GPS (DGPS) positions have a nominal accuracy of better than 3 feet (+/-). The EM stations are depicted as crosses in Figures 1-A and 1-B.

The EM inphase and terrain conductivity data were contoured using the statistical kriging routine in SURFER for WINDOWS by Golden Software. The terrain conductivity and inphase contours are depicted in Figures 2- (A & B) and 3- (A & B) respectively. Note that the conductivity contour levels are presented as shades of blue to green to red for increasing positive values and yellow for increasingly negative values (the equivalent of very high positive values — see above). The inphase contours grade from green (low values = no metallic response) to red or blue (high negative or positive values = metallic response).

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GPR

In order to provide an independent method of detecting non-metallic targets (i.e. carcass trenches), Enviroscan performed GPR scanning using a GSSI SIR-2 system. The system included a color display monitor, internal hard drive, and a shielded monostatic 500-megaHertz scanning antenna (generally capable of scanning to a depth of 8 to 10 feet while screening out interference from above ground or overhead structures and utilities).

GPR systems produce cross sectional images of subsurface features and layers by continuously emitting pulses of radar frequency energy from a scanning antenna as it is towed along a survey profile. The radar pulses are reflected by interfaces between materials with differing dielectric properties. The reflections return to the antenna and are displayed on a video monitor as a continuous cross section in real time and/or recorded for further analysis. Since the electrical properties of metals are dramatically different from soil and backfill materials, metallic objects produce distinct reflections. In particular, cylindrical tanks, drums, and utilities characteristically appear as smooth parabolic reflections on GPR records. Fiberglass, plastic, concrete, and terra-cotta targets as well as subsurface voids, rock surfaces, soil composition or moisture content variations, and concentrations of many types of disseminated metallic and non-metallic wastes also produce recognizable reflections.

The GPR survey was accomplished by hand-towing the scanning antenna across selected areas of the site where the vegetation was sufficiently low to allow good signal coupling between the antenna and the ground surface. These areas included several suspicious dirt mounds, suspected excavation pits, and over suspected utility lines based on the field-processed EM data. The profiles were inspected in real time as the survey progressed to identify parabolic reflections of the type commonly associated with utilities, or distinct/discrete zones of soil disturbance of the type commonly associated with pits or trenches. Where anomalous reflections of the type that might be associated with utilities or trenches were detected, numerous closely spaced and variously-oriented profiles were scanned to provide detailed delineation of the anomaly footprint.

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Results

The results of the geophysical survey are depicted in Figures 2-A, 2-B, 3-A, and 3-B. As described above, the EM inphase and terrain conductivity data represent primarily the shallow subsurface materials (i.e. less than 30 feet, with a peak response near 4 feet), with contributions from above-ground targets where the data coverage is within approximately 20 feet of surficial metallic materials. Based on these sensitivity characteristics, the EM data suggest the presence of utilities along the road bounding the eastern edge of Area 3, crossing the northeast portion of Area 2 on a northwesterly heading, and a metallic culvert along the road bounding the western edge of Area 4. Additionally, EM anomalies created by a manhole and a single steel 55-gallon drum are shown in Area 2 (Figures 2-B and 3-B).

Note that the mapped EM data coverage was limited in Areas 3 and 4 (Figures 1-A and 1-B) due to both dense vegetation (preventing access) and tree cover (preventing contact with the GPS satellites). In portions of Area 4 with accessibility, but no GPS coverage, non-positioned EM data was collected and examined in real time as the survey progressed. A single 55-gallon drum was observed both visually and on the EM data (but does not appear as an anomaly in the EM data due to the lack of GPS positioning). The drum was located approximately 75 feet southeast of the dirt mound posted in Figure 1-A. Additionally, the terrain conductivity low mapped around the dirt mound (Figure 2-A) appeared in the non-positioned EM data to continue southeastward along a topographic high. This terrain conductivity low may be related to suspected burial mounds, and/or to naturally low soil moisture or shallow rock.

GPR scanning of selected areas within Area 4 indicated randomly distributed parabolic reflections of the type consistent with disturbed soils, suspected tree roots, rocks, possible debris, and a number of other possible small objects across the site. Unfortunately, GPR scanning over selected dirt mounds indicated identical GPR reflections to those over apparently undisturbed ground (background). However, during the GPR survey, it became apparent that the majority of the observed dirt mounds in Area 4 formed six suspected trenches (Figure 1-A). GPR scanning in Area 2 detected linear alignments of parabolic reflections of the type consistent with buried utility lines (Figures 2-B and 3-B labeled "suspected utility line"). These suspected utility lines appear to head in the direction of the sewage disposal facility (located off the maps). GPR scanning did not detect anomalies of the type typical of pits or trenches within the other areas of the site.

Limitations

The geophysical survey described above was completed using standard and/or routinely accepted practices of the geophysical industry and equipment representing the best available technology. Enviroscan does not accept responsibility for survey limitations due to inherent technological limitations or site-specific conditions. However, we make every effort to identify and notify the client of such limitations or conditions. In particular, please note that utility mapping does not relieve any party of any legal obligation to notify a utility marking or one call service prior to digging or drilling.

Enviroscan has appreciated this opportunity to work with you. If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,
Enviroscan, Inc.
(b) (4)

(b) (4)
Geophysics Project Manager

Technical Review By:
Enviroscan, Inc.

(b) (4)
President

enc.: Figure 1-A: Geophysical Survey Data Coverage – Area 1 & 4
Figure 1-B: Geophysical Survey Data Coverage – Area 2 & 3
Figure 2-A: EM-31 Terrain Conductivity Data Contours – Area 1 & 4
Figure 2-B: EM-31 Terrain Conductivity Data Contours – Area 2 & 3
Figure 3-A: EM-31 Inphase Response Data Contours – Area 1 & 4
Figure 3-B: EM-31 Inphase Response Data Contours – Area 2 & 3
Appendix A: EM-31 Depth Sensitivity

Figure 1-A

Geophysical Survey Data Coverage Area 1 & 4

Flow Laboratories Site
Dublin, VA

Enviroscan, Inc.
Project No. 050048
Rev. 09/18/00

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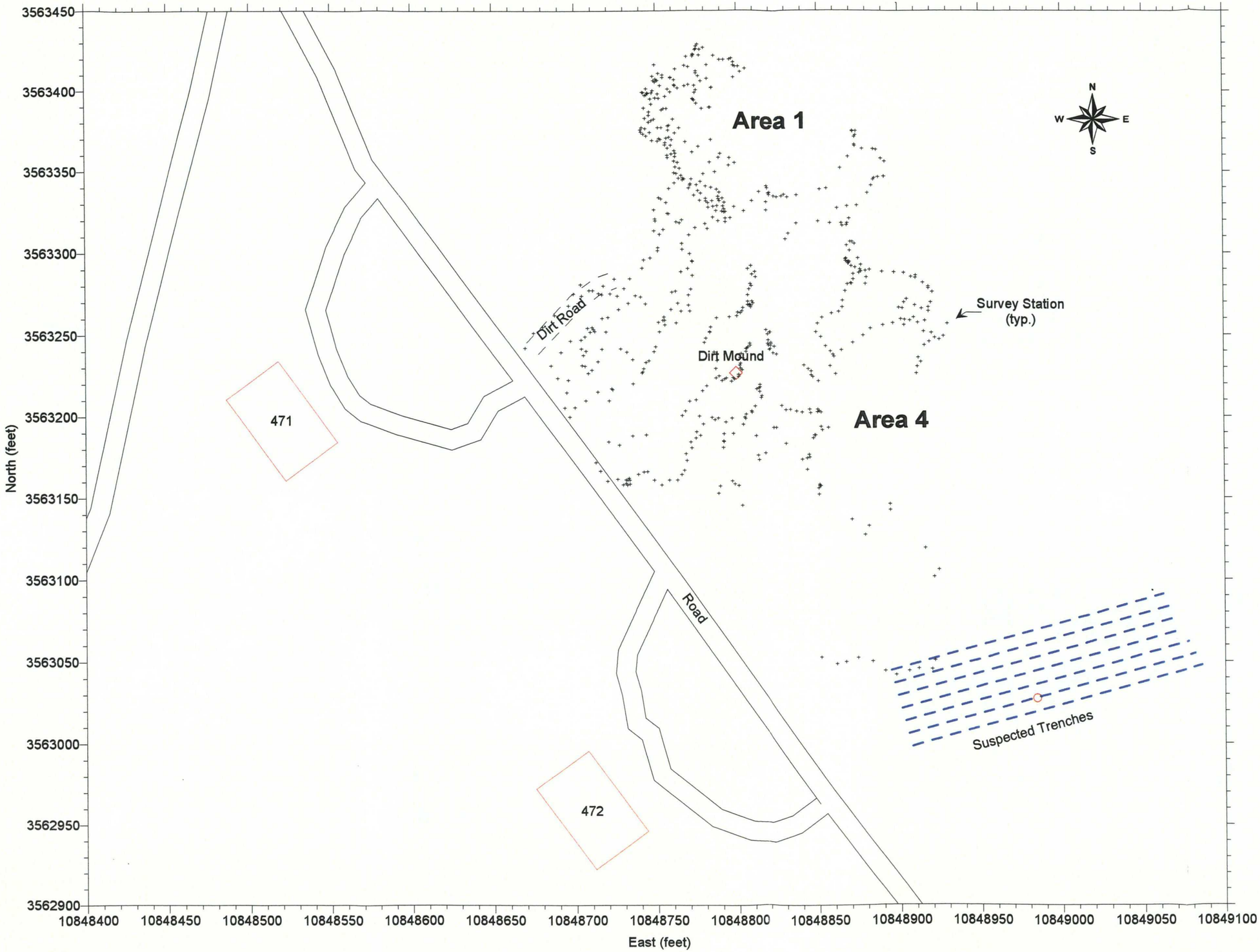

Notes:

Coordinates in VA South State Plane Grid, NAD-83 geodetic datum.

Base map features and survey stations from DGPS survey by Enviroscan, Inc. (every 3rd survey station shown for clarity)

Data from Geonics, Ltd. EM-31, vertical dipole mode.

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Figure 1-B

Geophysical Survey Data Coverage Area 2 & 3

Flow Laboratories Site
Dublin, VA

Enviroscan, Inc.
Project No. 050048
Rev. 09/18/00

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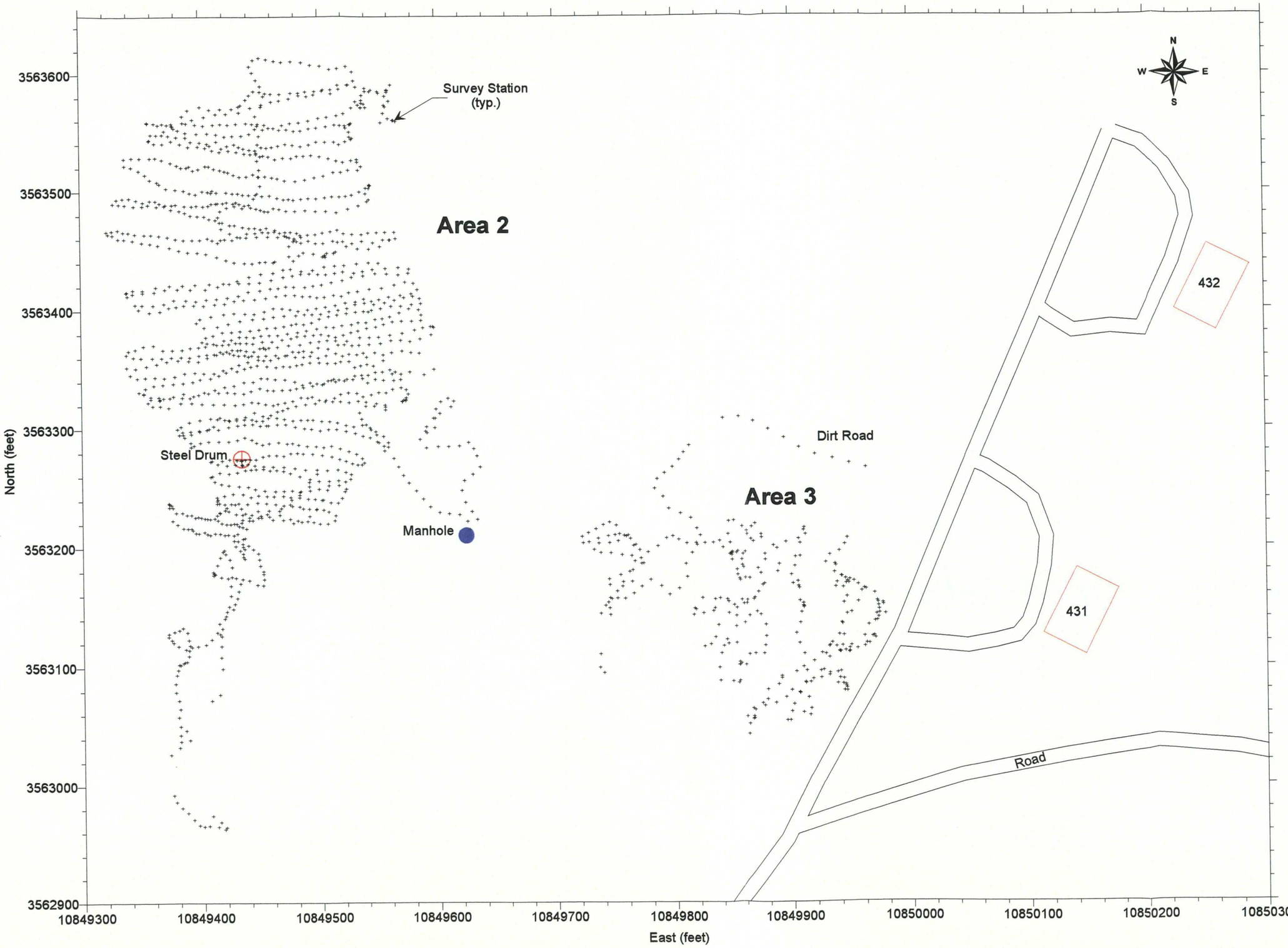

Notes:

Coordinates in VA South State Plane Grid, NAD-83 geodetic datum.

Base map features and survey stations from DGPS survey by Enviroscan, Inc. (every 3rd survey station shown for clarity)

Data from Geonics, Ltd. EM-31, vertical dipole mode.

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Figure 2-A

EM-31 Terrain Conductivity Data Contours Area 1 & 4

Flow Laboratories Site
Dublin, VA

Enviroscan, Inc.
Project No. 050048
Rev. 09/18/00

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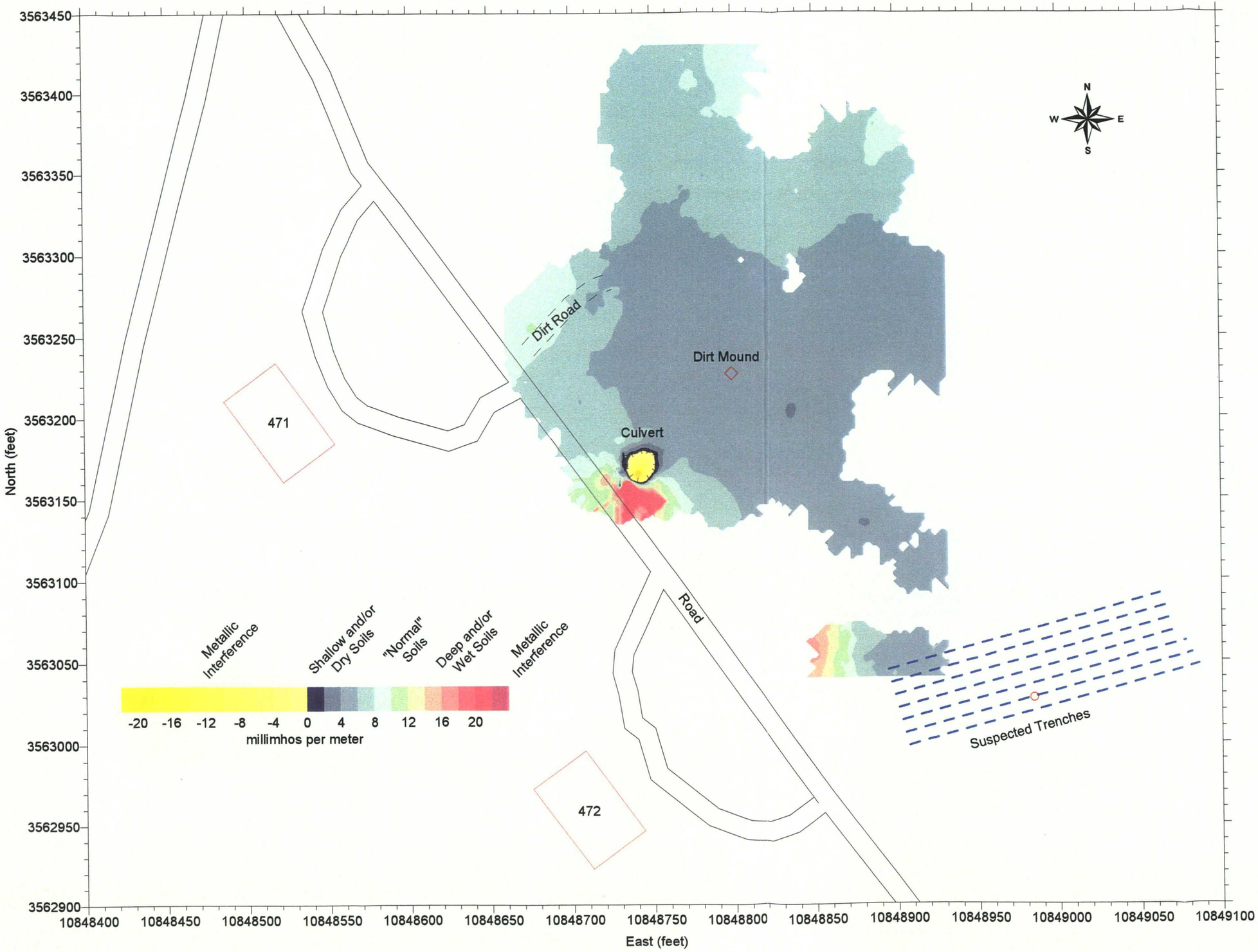

Notes:

Coordinates in VA South State Plane Grid, NAD-83 geodetic datum.

Base map features from DGPS survey by Enviroscan, Inc.

Data from Geonics, Ltd. EM-31, vertical dipole mode.

Figure 2-B

EM-31 Terrain Conductivity Data Contours Area 2 & 3

Flow Laboratories Site
Dublin, VA

Enviroscan, Inc.
Project No. 050048
Rev. 09/18/00

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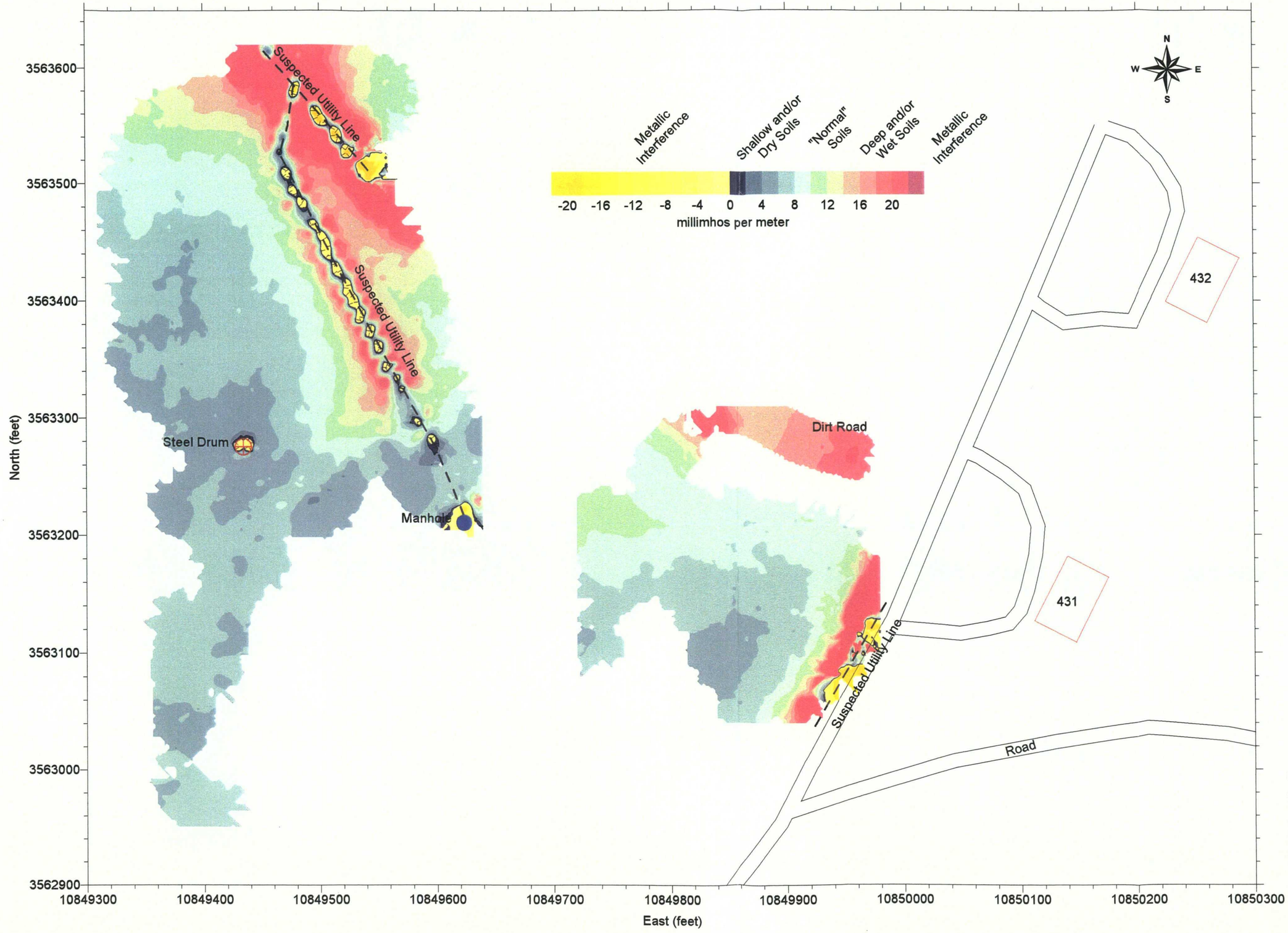

Notes:

Coordinates in VA South State Plane Grid, NAD-83 geodetic datum.

Base map features from DGPS survey by Enviroscan, Inc.

Data from Geonics, Ltd. EM-31, vertical dipole mode.

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Figure 3-A

EM Inphase Response Data Contours Area 1 & 4

Flow Laboratories Site
Dublin, VA

Enviroscan, Inc.
Project No. 050048
Rev. 09/18/00

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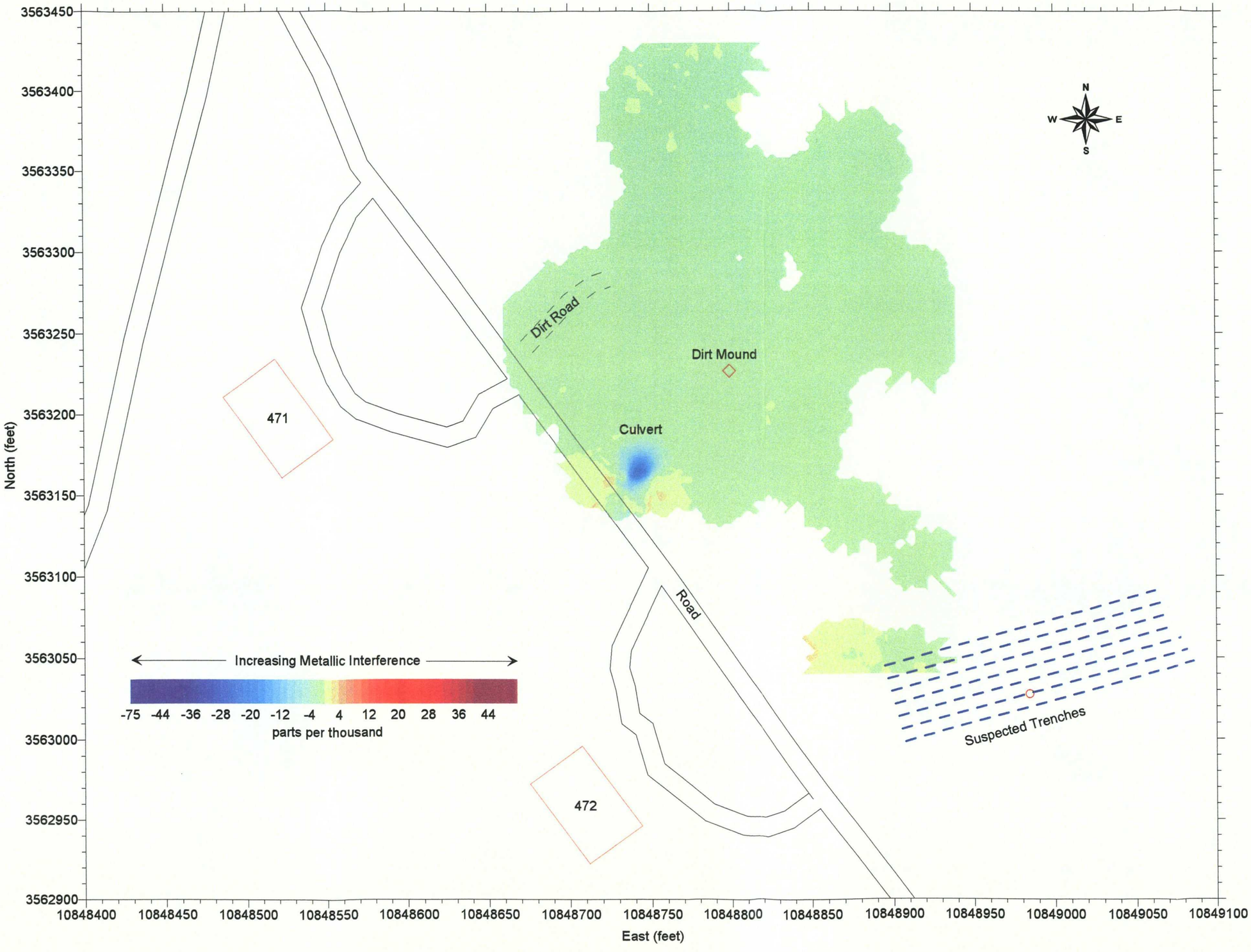

Notes:

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Base map features from DGPS survey by Enviroscan, Inc.

Data from Geonics, Ltd. EM-31, vertical dipole mode.

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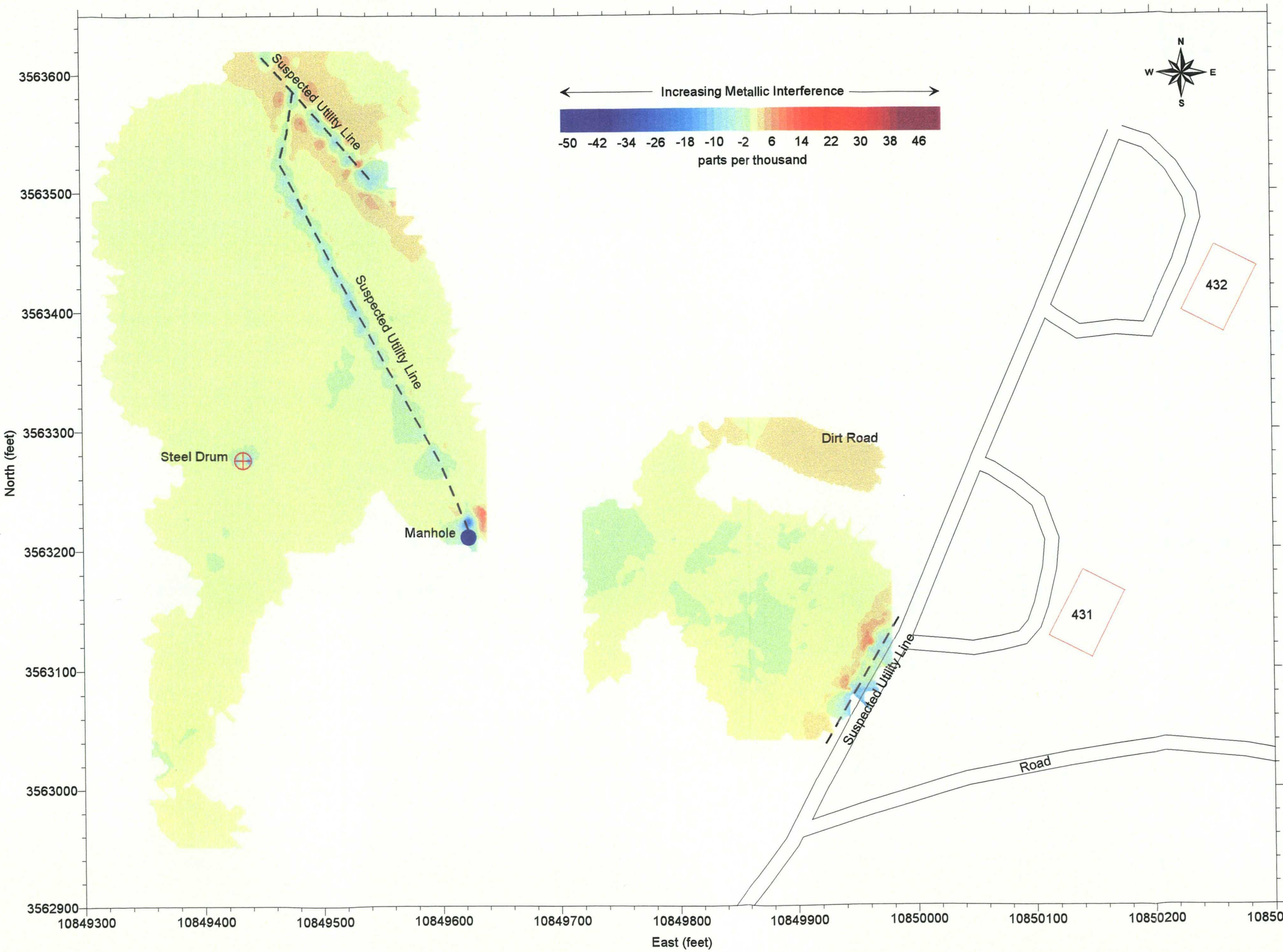
Figure 3-B

EM Inphase Response Data Contours Area 2 & 3

Flow Laboratories Site
Dublin, VA

Enviroscan, Inc.
Project No. 050048
Rev. 09/18/00

ENVIROSCAN, INC.



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Coordinates in VA South State Plane Grid, NAD-83 geodetic datum.

Base map features from DGPS survey by Enviroscan, Inc.

Data from Geonics, Ltd. EM-31, vertical dipole mode.

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Appendix A

EM-31 Depth Sensitivity

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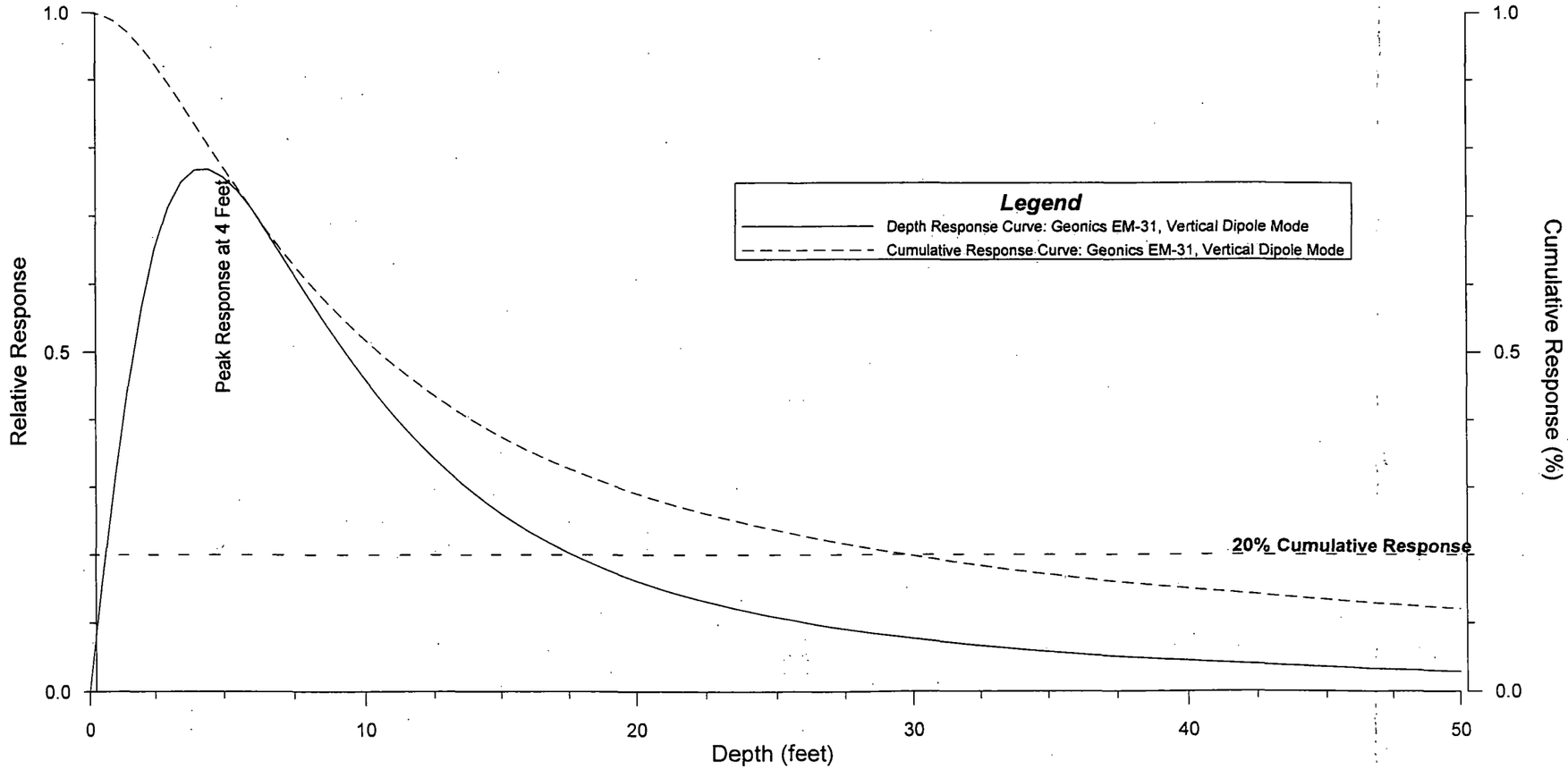

Appendix A

EM-31 Effective Survey Depth

ENVIROSCAN, INC.